Instructions for use

MACH LED 2SC HYBRID

Mach LED 2SC Hybrid mobile light 190 430 1200
Mach LED 2SC Hybrid mobile light with emergency power battery..... 190 430 1500
Mach LED 2SC Hybrid wall model 190 430 2100
Mach LED 2SC Hybrid wall model for room heights to 2,8m 190 430 2101
Mach LED 2SC Hybrid ceiling light for room heights to 2,8m 190 430 3127
Mach LED 2SC Hybrid ceiling light for room heights 2,8m – 3m..... 190 430 3130

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Dear customer!

Congratulations for acquiring our new OT-light **MACH LED 2SC Hybrid**.

The new OT-light generation with LED technology supports your professionality by innovative technology and design.

The advantages of the LED technology: adjustable light color, a life-span of minimum 40.000 hours and an almost nonexistent heat development in the surgeon's head area and in the wound field.

The advantages already provided by Dr. Mach's light technology with halogen and gas discharge lamps have been maintained: natural color reproduction, exact illumination of the wound field and easy positioning of the light head.

1. Safety instructions

Pay attention to the instructions for use when handling the lamp.

WARNING:

This device has not been designed for use in potentially explosive areas.
According to the Medical Device Regulation the light is classified under class I.

Store the OT-light in its package for at least 24 hours in the respective room before mounting, in order to equal temperature differences.

Please read the instructions for use carefully to make the most of your lighting system and to avoid any damages to the device.

The lights may only be repaired and special assembly work may only be carried out on the reflector or sockets by ourselves or a company that has been expressly authorized by us.

The manufacturer can only be made responsible for the safety of the light if repairs and alterations are carried out by the manufacturer himself or a company that guarantees to observe the safety regulations.

The manufacturer cannot be made liable for personal or material damages if the light is operated inexpediently or incorrectly or used for purposes other than those for which it is intended.

The light is to be dismantled from the spring arm in reverse order to its assembly. This may only be carried out after the spring arm has been adjusted in height at horizontal position since the arm is under spring tension and can bounce up.

Make sure that the light is in perfect working order before every use.

Attention, external power supply!
The light works only with an external power supply 250VA.
The external power supply used with the OT-light must be tested and validated according to IEC 60601-1.

Attention!
A main control switch must be installed for turning the system power-off.

ATTENTION!

During the mounting of the OT-lights the entire system (incl. the ceiling attachment) must be disconnected from mains! A later dismounting of the lights from the spring arms or dismounting the sliding contacts inside the arms is to be done ONLY AFTER DISCONNECTING THE ENTIRE SYSTEM FROM MAINS. Otherwise the main control board will be damaged!

Symbols and notes used in this user manual:

This symbol means possible hazard sources. Please observe also the safety remarks and the hazard specifications mentioned in the mounting instructions and user manuals from Ondal company.

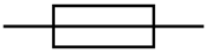
This symbol means possible hazard caused by electric current. Please observe also the safety remarks and the hazard specifications mentioned in the mounting instructions and user manuals from Ondal company.

This symbol refers to important mounting indications, useful information and operation hints.

This symbol indicates to observe the user manual.

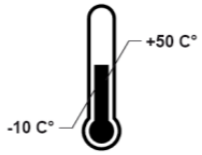
Alternating current

Bulb



Fuse

Indication on China RoHS / Pollution control Logo China



Temperature range for transport and storage

Indication for disposal

2. Brief description of the light Mach LED 2SC Hybrid

Intended use of the light Mach LED 2SC Hybrid:

- The light is used for treatment, diagnosis and in operating theatres.
- The light is used in medical rooms (groups 0, 1 and 2 according to DIN VDE 0100-710).
- The light is mounted to the ceiling, to the wall or on a mobile stand.
- Maintenance of the light should be scheduled every 2 years.
- The light has a fixed electrical connection (ceiling lights and wall lights).

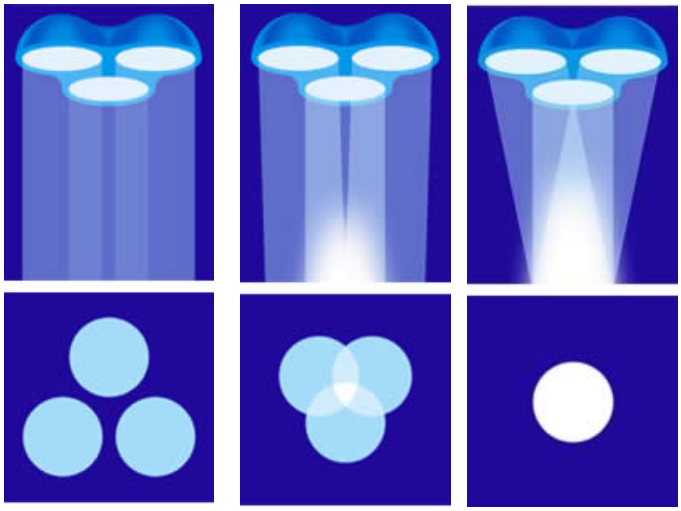
The OT-light MACH LED 2SC Hybrid is available in following versions:

- Mach LED 2SC Hybrid with merging of light fields and light intensity control.

The OT-light Mach LED 2SC Hybrid offers two different operating modes for the doctor:

- **OT-mode**
  The light can be used as a normal OT-light for the oral and maxillofacial surgery. All functions of the light are available: changing of the light field size, depth light, light intensity control.

- **Dental-mode**
  The light can be used as a treatment light for dentistry. The photometric properties of the dental-mode are orientated to the standard DIN EN ISO 9680 (Dentistry-Operating lights).
  The outer LED units turn off and the illuminated central LED unit creates an oval-shaped light field for the glare-free illumination of the oral cavity.



2.1. Merging of light fields

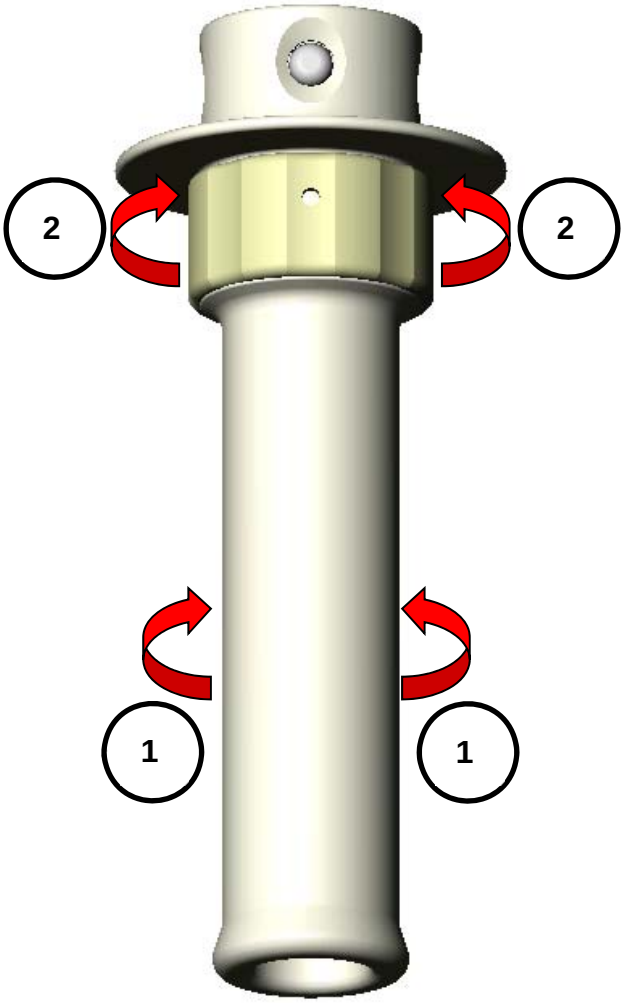
The OT-lights **MACH LED 2SC Hybrid** offer light field adjustment by **merging the individual light fields** of each LED unit by swiveling them.

NOTE: This feature is activated by turning the sterilisable handle.

2.2. Light intensity control

The OT-lights **Mach LED 2SC Hybrid** offer the feature of light intensity control.
You can adjust the light intensity between 50% and 100%; according to your requirements

3. Light functions operated at the sterilisable handle

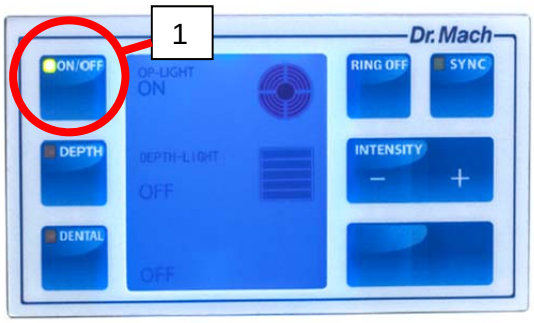


Depth light
The depth light can be activated by a tight-turn of the ring at the sterilisable handle. A left-turn of the ring switches the depth light OFF.

The depth light function on the ring is preset by Dr. Mach at delivery. The customer can transfer all other available functions of the LED-light to the ring on request. The transfer procedure is described in the following chapters.

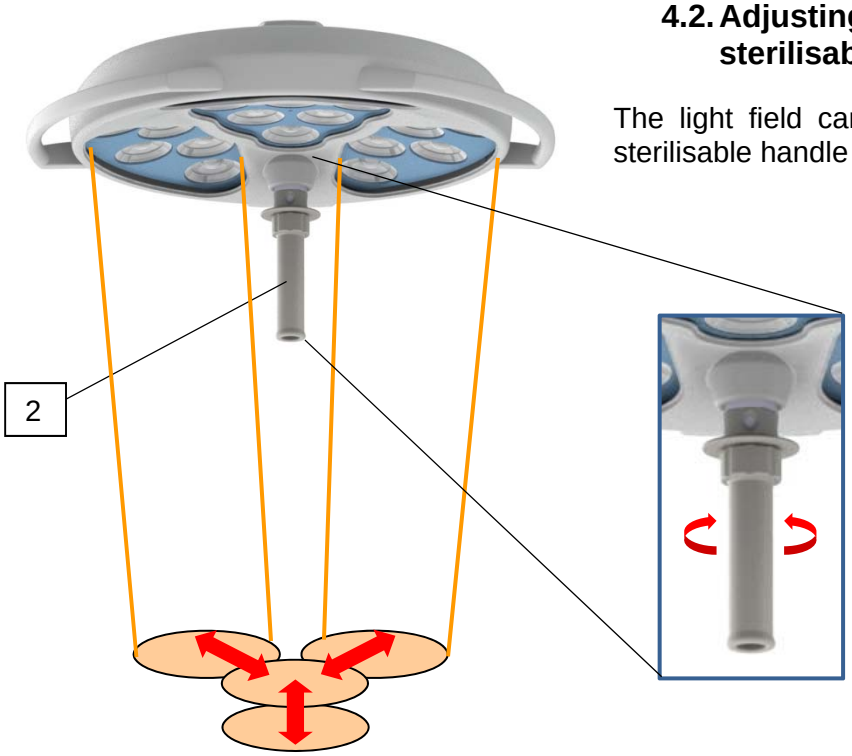
Merging of light fields
The four light fields of the outer LED-units are merged to one light field by turning the handle sleeve.

4. Operating the light Mach LED 2SC Hybrid



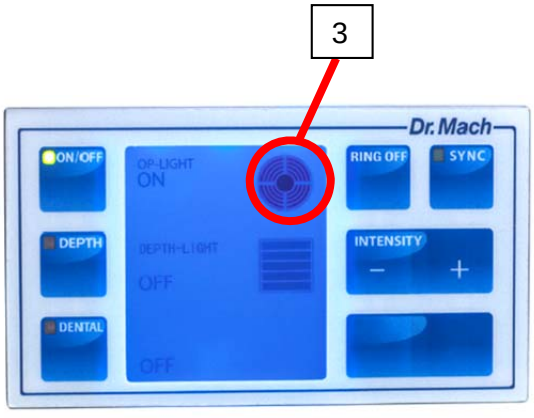
4.1. Turning the light ON and OFF

The push button **1** on the control panel turns the light **Mach LED 2sc** ON and OFF.



4.2. Adjusting the light field with the sterilisable handle

The light field can be adjusted by turning the sterilisable handle **2**.



The function of light field adjustment is available only in OT-mode.

The current size of the light field is shown by the digital display **3**.

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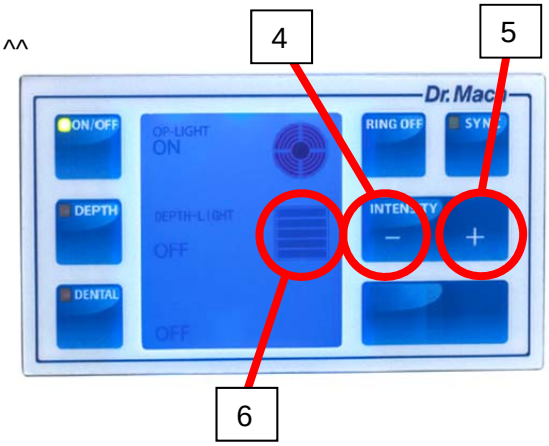
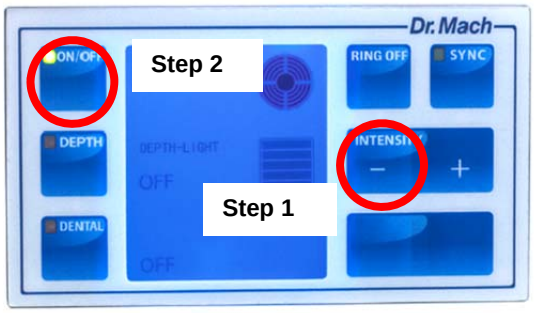


4.3. Light intensity control

Select the desired light intensity before surgery. It is recommended to start with 80% of the maximum light intensity and to increase the light intensity in time.

At these models the adjustment is done by the control panel at the cardanic bow. The intensity can be adjusted between 5% and 100%.

By pressing push button **4** the light intensity decreases.
By pressing the push button **5** the light intensity increases.
The current light intensity level is shown by the digital display **6**.



Transferring the light intensity adjustment function to the ring of the handle
In order to transfer the light intensity adjustment function to the ring of the sterilisable handle, press first push button **4** or **5** and then the **ON/OFF** button on the key pad.
The frame around the light intensity level display is blinking.

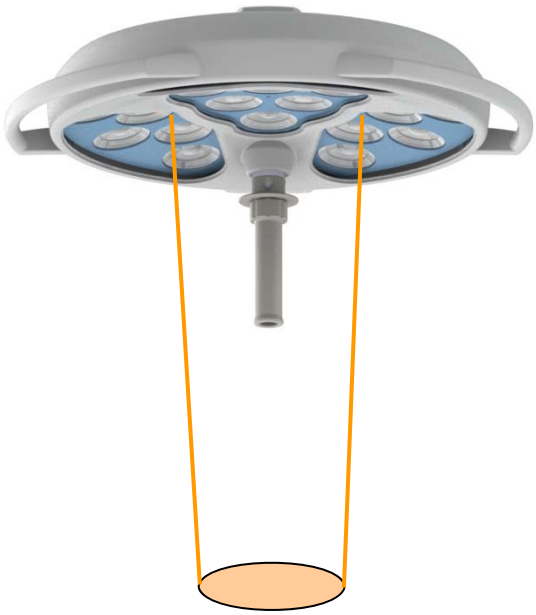
The previous function on the ring is deactivated.

A right-turn of the ring at the handle increases the light intensity by one step; a left-turn of the ring decreases it with one step.

4.4. Depth light

You have the possibility to increase the light intensity of the central segment of the OT-light. This enables an optimum illumination of the wound field according to its texture and the shadowing effects.
This is very important in case of small and deep wound channels.
The depth light is to be switched on only if an increased depth illumination is needed.

To activate the depth light press push button **7** on the control panel.



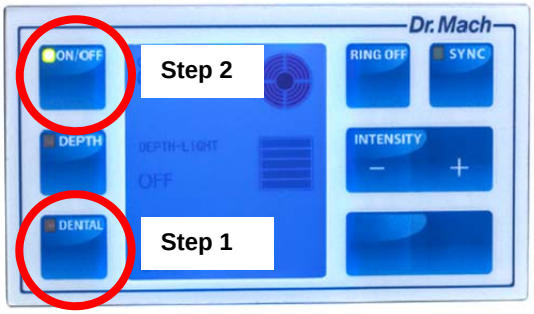
4.5. Dental-mode

The light can be used as a treatment light for dentistry.

The outer LED units turn off and the illuminated central LED unit creates an oval-shaped light field for the glare-free illumination of the oral cavity.

To activate the dental mode press push button **8** on the control panel.

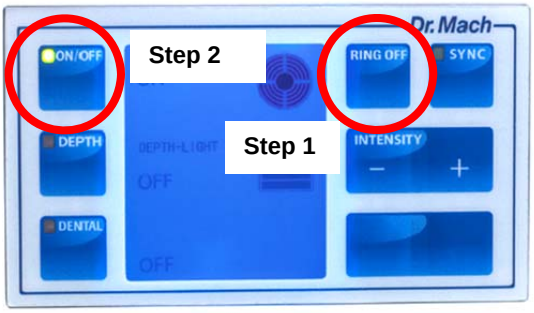
The function of light intensity control is available in both modes: OT-mode and dental-mode.



Transferring the dental-mode function to the ring of the handle
In order to transfer the dental-mode function to the ring of the sterilisable handle, press first the **DENTAL** push button and then the **ON/OFF** button on the key pad.
The display ON near the DENTAL push button is blinking.

The previous function on the ring is de-activated.

A right-turn of the ring at the handle activates the dental-mode; a left-turn of the ring deactivates the dental-mode.



4.6. Deactivating all functions on the ring of the handle

The functions on the ring of the handle can be completely deactivated. Press first of all push button **RING OFF** and then the **ON/OFF button** on the key pad.
The ring on the handle is without function.

In order to transfer a function on the ring, please proceed as described in the chapters before.

4.7. Communication with a wall panel

The lights Mach LED 2SC Hybrid can be operated by communicating with a wall panel. This function is available against surcharge.

The communication is activated and deactivated by pressing the push button **SYNC** on the key pad of the light.

4.8. Basic operating mode of the communication on Dr. Mach LED lights

The communication of the Dr. Mach LED lights is realized with a single-wire bus.

The members of the communication bus have star-shaped connections. All the members of the commu-nication bus need an explicit communication number which is to be set with the first two dip-switches on the control board. Due to the fact that two dip-switches are reserved for ad-dressing, maximum four inde-pendent lights can be connected to the communication bus. The communication number of each light is pre-set by the factory and can be changed during instal-lation on site only by opening the light head. The communication number is shown by the sticker “Sync address” on each 5-pole light head. Usually at Dr. Mach the LED 3 lights have the pre-set sync address = 0 and the LED 5 lights have the pre-set sync address = 1. Although the sticker is labeled “Sync Address”, it refers not only to the communication be-tween the light heads, but also to the communication to the wall panel. The light heads of a system must have different sync addresses; otherwise the communication is not working perfectly. If it is known after plac-ing the order that a combination LED 3 / LED 3 and another combination LED 5 / LED 5 was ordered, these combinations will be pre-set with different sync addresses. This way it is ensured that the lights must not be opened at installation. It means also that in case of deliveries with many lights for many operation theatres it must be observed very carefully, which lights are go-ing to be combined.

The communication of the lights with the wall panel works with the same single-wire bus. On the control board inside the wall panel there is the dip switch 4 which defines that this control board is working as a wall panel. The dip switch inside the wall panel must be in “ON” position. The control boards inside the wall panel must have the same sync address as the lights they are assigned for. The same communica-tion address on the control board inside the light and the control board inside the wall panel makes sure that the communication with the wall panel is working.

Technical remarks regarding the communication
The communication between the lights and between lights and wall panels is working through one cable. The voltage on this cable in standby modus is approx. 5-6V.
The communication wire can be found on the control board besides the connections for the power supply. The wire leads directly to the controller chip. The controller pin is quite sensitive to negative voltages. This means that if there is a negative voltage bigger than –0,3V on the communication pin, this pin gets damaged and lies on a voltage of approx. 1V.

After a correct installation and during regular operation no negative voltages occur. However, during the light installation and wiring equalizing currents can appear, which lead to a negative potential on the communication pin relative to the 0V wire. In this case the pin gets damaged. This is the reason why dur-ing installation the power supply of the entire system must be com-pletely switched off and there must be no residual energy in the capacitors (electronic power supply and light head). The electronic power sup-plies are equipped with quite big-sized capaci-tors, which have high voltages for several minutes after switching off the primary voltage. The capacitors must be discharged before the communication lines of the light and the wall panel are connected.

The reference potential for the communication is the 0V wire of the power supplies. Due to the fact that each light needs its own power supply, the 0V wires of the power supplies must be connected to each other in order to create the same reference potential for the communication. Usually the wiring on the flange is factory-made. However during installation it should be ob-served that the 0V wires of all the power supplies that are used for lights with communication, are bridged.

The protective conductor (green-yellow) has no use for the communication. There must not be any con-nection between the protective conductor and the communication line, because it cannot be ensured that the protective conductor has a 0V potential all the time. In case the communication line is in contact with the protective conductor due to an installation error it is possible that the communication does not work correct. Eventually the function failure is not directly visible and consists of sporadic malfunction or re-peated pressing of the keys on the keypad in order to control the light.

Information about the power supply

The Dr. Mach LED lights need a direct current voltage of 24V-30V DC for correct operation. The undula-tion of the direct current voltage should not exceed 5%. The LED control inside the light is current-operated, that means that a change of the supply voltage does not lead to a change of the light intensity. Due to the fact that the power requirement of the light is constant, an increase in the supply voltage means a decrease of the total current of the light and therefore to a decrease of the heat development inside the light. That is why it is recommended to supply the light with a high voltage, so the life span of the component parts is not shortened by an exceeding heat development.

The control electronics of the light has an initial voltage at starting of approx. 17V. This voltage value is too low for the light operation. The light can be operated with 20V DC for a short time, but in this case the heat development will be very high, which has a negative influence on the life span of the component parts. The initialisation phase of the control electronics is approx. 1 second. In case that the supply volt-age does not reach 24V-30V within this second, the cluster board of the lights can be damaged. This is the reason why a soft start, which makes sense for halogen lights, is not allowed for LED lights.
The capacitances inside the light and the LED control cause quite high current peaks when turning on the power supply. The current peaks are in the range of the sevenfold rated current. A current limiting and a protection of the lights should not delimitate the current peak, because the electronic boards would even-tually consider this delimitation as a failure in power supply and would change to emergency operation mode. The emergency operation mode does not ensure a normal functionality of the lights and must be avoided.

Swapping the polarity at the LED light does not lead to a malfunction. After the polarity is changed, the light works perfectly. A wrong polarity can happen by swapping the wires inside the spring arm, horizontal arm or ceiling flange tube, but also inside the transformer housing or the light. The error code for wrong polarity on the light display is C0--. The display is on, but the light is not working. If the polarity is swapped only at one of the lights and the lights are equipped with communication, caution is advised when changing the polarity at the ceiling flange. If the polarity at the power supplies is correct and the polarity on the ceiling flange is changed only for one light, it may happen that due to the bridge between the 0V lines of the power supplies the 28V line of one power supply is connected to the 0V line of the other power supply. The function of the lights is OK, the connection of the power supplies is not. The power supplies are working one against the other.

Troubleshooting

If a communication error on an installed system must be found, first of all the neutral point, where all communication lines are connected, must be disconnected. The disconnection must be done only after the primary supply voltage was turned off. On the free lines the open-circuit voltage must be checked. After switching on the supply voltage all displays must work and the voltage measured on every communication line must be 5V-6V. The voltage is meas-ured with the OV line of the power supplies (normally the blue terminals on the flange).

If the measured voltage is not correct (i.e. 1V), the communication pin is damaged and the control board of the light must be exchanged. If the measured voltage is 0V, the line is not connected to the communication pin of the control board.

If the measured voltages are correct, please connect first of all the communication lines of the lights and check their correct function. If there is a wall panel on site, do not connect it yet to the communication line. Transmit the values of one light to the other lights and check the function. If the communication is not working, the malfunction must be located in the light attachment. In order to resolve the problem, the spring arms, the horizontal arms and the ceiling tube cables must be changed individually and one after another.

If the communication between the lights is working, the wall panel can be connected and the function can be tested. If the communication is not working, please check the connections in the wall panel and the settings of the DIP switches. Please look also for damaged crimp connections, where single strands can cause a short circuit.

Installation instructions for LED-lights with communication / synchronization

After installing the ceiling flange, the central axis, the horizontal arm and the power supplies, the lights must not be mounted to the spring arms yet.
Insert the 5-pole test adapter into the spring arm. The test adapter can be purchased at Dr. Mach. Then the ceiling attachment is connected to mains. On the marked terminals of the test adapter the voltages + 28V DC and 0V must be checked.

In the next step it must be checked if there is a connection between the communication wire on the test adapter and the corresponding wires on the ceiling flange. The communication wires on the flange are not yet connected. All the communication wires in the flanges are loosen.
If the supply line with + 28V and 0V is correct, the light head can be mounted and connected. That means that the test adapter has to be removed and the light head has to be connected. Before connecting the light head please disconnect the ceiling attachment from mains. That means that the power supply must be disconnected from mains on the primary side.
After disconnecting from mains please wait 20-30 seconds, until the capacitances on the power supplies are discharged. In order to speed up this process, the light can be turned on.

After the light head has been mounted and connected, connect the power supply to the mains and check the function of the light. All the functions on the keypad must work, there must be no error code on the display, no triangle must be shown on the display.

If the light function is OK, then proceed the same way with the other lights of that ceiling attachment. The communication wires are not yet connected. That will follow with the next step.

After all the lights of the ceiling attachment are working, please measure the voltages on the communica-tion lines. The measured voltage on the communication line must be between 5V and 6V. The voltage must be measured between the communication line and the blue terminals on the flange. This is the 0V line (or in correct electrical terms the minus-line).

If these 5-6V are not measured on the communication line, then there is a fault on the communication line. In the worst case the communication pin on the control board is damaged. If the communication pin on the control board is damaged, the measured voltage is 0,6V up to 1,2V.

The 5-pole sliding contacts have 3 supply lines, one communication line and a fifth line which is not allo-cated today. This fifth line is not connected in the light head either. There must not be measured any potential on this line. This means that in case a measurement is done on this line, the measured value must be 0V.

Due to the possibility of checking the lines by measuring the potential on them, the colour markings of the wires are no longer the only criteria to install and connect the lights in a correct way. Unfortunately we discovered that in the past the colours have been swapped because of changes of the colours of the wires and because of wiring errors at spring arms and horizontal arms.

In case the 5-6V are measured on the communication lines of each single light, it means that the commu-nication line is working correctly. Please disconnect the primary side of the power supplies from mains again, so all light heads are current less.

Please wait again for 20-30 seconds, until the capacitances on the power supplies are discharged. In order to speed up this process, the light can be turned on. Then the communication wires can be con-nected to the orange terminals on the ceiling flange.

After the communication wires have been connected, connect the primary side of the power supplies to the mains and the check the synchronisation function between the light heads.

If the synchronisation is working, it means that the wiring of the communication wires is correct and the signal transmission is OK.

In case the synchronisation is not working, a troubleshooting must be performed.

Assuming that the communication is working and a wall panel must be connected, the next step is to supply the wall panel with 28V DC. The wall panel is connected with four lines. Two of these lines are for the power supply.

The lights are turned off, the power supply must be disconnected on the primary side from mains. Wait 20-30 seconds, until the capacitances on the power supplies are discharged. In order to speed up this process, the light can be turned on.

Now the supply line for the wall panel is to be connected.

Connect these two lines on the ceiling flange, so you can measure + 28V DC and 0V at the wall panel. Do not connect the communication line for the wall panel yet.

After the connection has been done, the power supplies are connected to mains. Turn on the lights and check if the wall panel is supplied with power.

Please check if all functions are shown correctly on the display. A communication with the lights doesn’t work yet, since the communication line is not yet connected.

If the wall panel is working correctly, disconnect the power supplies from mains and wait until the capaci-tances on the power supplies are discharged. In order to speed up this process, the light can be turned on.

Now connect the communication line from the wall panel to the orange terminals on the ceiling flange.

Connect the primary side of the power supplies to mains and check if the communication between wall and light is working.

4.9. Positioning

Use the sterile handle **10** or the handle rails **9** to position the lamp.

Use the handle rail to position the lights before the operation.

Use the sterile handle for positioning during the oper-ation. This handle can be removed for sterilisation.

5. Cleaning

5.1. Sterilisable handle

At delivery the lamp is equipped with the handle sleeve **11**. The handle sleeve is removable and sterilisable. Before using the first time and be-fore every use the handle sleeve must be cleaned, disinfected and sterilised.

The handle sleeve must be removed for sterili-sation:

- To remove press the lock **V** and pull off the sterilisable handle sleeve **11** while keeping the lock pressed.
- To attach, push on and slightly twist the handle until the lock **V** engages securely.

Handles often become unsterile during an operation. Therefore always keep additional handles available for exchange.

Cleaning / disinfection and sterilisation

Basics

Efficient cleaning / disinfection are essential requirements for an effective sterilisation of the handle.

Within the scope of responsibility for the sterility of the products it should be noted that only suf-ficiently validated equipment and product specific processes are used for cleaning / disinfection and that the validated parameters are complied with in every cycle.

In addition, the hospital / clinic hygiene regulations must be observed.

Cleaning / disinfection
Cleaning and disinfection must be carried out immediately after use.
A mechanised process (disinfector) should be used for cleaning / disinfection. The efficiency of the process used must be recognised and validated in principle (e.g. listed under disinfectants and disinfection procedures tested and recognised by Robert-Koch-Institute / DGHM).
When using other procedures (e.g. a manual procedure), proof and process efficiency in principle must be provided within the scope of validation.
Proof in principle of the suitability of the handles for efficient cleaning / disinfection was provided using a cyclic cleaning system (Netsch-Bellmed T-600-IUDT/AN, programme 2 for small parts; code B).

It is not allowed to use agents / disinfectants, which contain the following substances, as these may cause changes in the material:

- High-concentration organic and inorganic acids
- Chlorinated hydrocarbons
- 2-ethoxyethanol

When cleaning / disinfecting, the following procedures must be followed:

	Process	**Time (sec.)**
Zone 1	Pre-rinse, external, cold, 10 – 15°C Washing, acidic, external 35°C Draining time Re-rinse, external approx. 80°C Draining time Re-rinse, external approx. 80°C Draining time	**45** **120** **10** ***10** ***15** ***15** **15**
Zone 2	Washing, alkaline, external, 93°C Draining time Re-rinse, external, acidic, 90°C Draining time Re-rinse, external 90°C Draining time	**135** **10** **10** **15** **15** **15**
Zone 3	Drying, external 100 – 120°C	**200**
Zone 4	Drying, external 100 – 120°C	**200**
	Door open / close & transport (sluice discharge)	**60**
	Cycle time overall ca.	**290** **≈ 5 minutes**

* When occupying the disinfection zone (washing zone 2), the re-rinse and draining times will depend on the respective objects being washed therein!

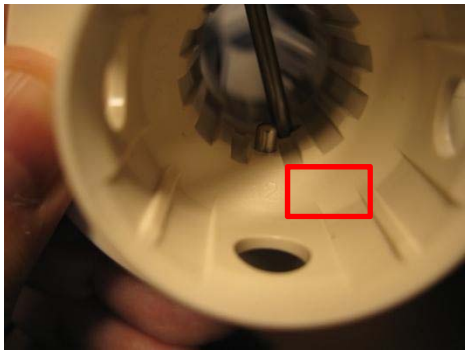
Sterilization

Only previously cleaned and disinfected handles may be sterilised.
The handles are placed in a suitable sterilisation pack (one-way sterilisation pack, e.g. foil / paper sterilisation bags, single or double pack) in accordance with DIN EN 868 / ISO 11607 for steam sterilisation and then sterilised.
Use only the sterilisation procedure listed below for sterilisation. Other sterilisation procedures (e.g. ethylene oxide, formaldehyde and low-temperature plasma sterilisation) are not permissible.

Steam sterilisation procedure
Validated in accordance with DIN EN 554/ISO 11134
Maximum sterilisation temperature 134°C

Proof in principle of the handles' suitability for effective sterilisation was provided using a fractional vacuum process (Euroselectomat 666 by MMM Münchner Medizin Mechanik GmbH, sterilising temperature 134°C, holding time 7 min.)

Inspection / durability



The sterilisable handle sleeve must be disposed after 1000 sterilisation cycles or at the latest after 2 years and replaced with a new one.

The year of manufacture can be determined with the help of a stamping on the inner side of the handle sleeve (like shown in the photo). The stamping in the photo shows the number 12, which stands for the year 2012.

5.2. Lamp housing, protective disk and support system

The Dr. Mach OT-lamp system has a high-quality surface, which can be cleaned with conventional cleaning agents.

The protective disk **12** is made of a high-quality plastic. Pay attention to the following during cleaning:

- Never wipe over the protective disk **12** with a dry cloth (always clean with a wet cloth).
- Only use disinfectants with **less than 20% alcohol**.

Alc. ≤ 20 %

Wipe the protective disk **12** after cleaning with an antistatic, non-fluffy cloth.

6. Maintenance

MACH LED 5MC/SC lights are supplied with brakes on the suspension fixture and on the lamp housing. Adjust these brakes, if necessary, after installation.
Preventive maintenance of the light should be done every two years. This includes a technical and mechanical check-up.
Please observe also the manufacturer's mounting instructions for the ceiling and wall attachment.

In order to keep the system easy-running throughout its life span, we recommend that the hinges should be greased once a year with acid-free grease.

Attention:
Set the height adjustment, if applicable, of the spring arm to horizontal position before dismounting the lamp, (Please observe also the manufacturer's mounting instructions for the ceiling and wall attachment).

Attention: During all maintenance work the light must be disconnected from mains and secured against resetting.

6.1. Periodical maintenance work

The following maintenance work / tests has / have to be done every six months:
- check on defects in paint work;
- check on fissures at plastic parts;
- check on deformation of the suspension.

The following maintenance work / tests has / have to be done once a year:
- check the function;
- electrical safety test;
- check the suspension.

Check and grease the security segment once a year.

For adjustments at the ceiling attachment please observe also the mounting instructions "**Ceiling attachment with heavy central axis**":

7. Troubleshooting

In case of a malfunction of the light an error code is shown on the display of the key pad, as shown in the picture on the left.

The error codes consist of four digits.

The error shown on the display is always the error with the highest priority:

- Errors of the control board are prior to errors of the cluster boards.
- Clusters with lower adress have higher priority.
- General cluster errors are prior to errors of the LED channels.
- In case of general cluster errors the lower numbers have the higher priority.

Decoding

Digit 1	Digit 2	Digit 3	Digit 4		
c	**0-7**	*****	*****	Cluster errors always begin with the letter '**c**'; digit 2 is the cluster adress (0-7)	
c	**0-7**	**-**	**-**	No contact to the cluster	
c	**0-7**	**-**	*****	General cluster error (reported by the cluster); reset by switching ON and OFF	
				Digit 4 = Bit-number oft he error (MADATAID_CANPAR_STATUS_xxx)	
c	**0-7**	**-**	**0**	WDRESET	CPU was reset by WD
c	**0-7**	**-**	**1**	SWRESET	SW reset because of fatal error
c	**0-7**	**-**	**2**	FLASHCRC	FLASH CRC error
c	**0-7**	**-**	**3**	RAMERR	RAM test error
c	**0-7**	**-**	**4**	NOEEDATA	no EEPROM data, defaults were used (SerNum etc. lost)
c	**0-7**	**-**	**5**	EEDEFAULT	EEPROM paramater defaults were set (SerNum etc. preserved)
c	**0-7**	**-**	**6**	EEWRERR	EEPROM write error when writing parameters
c	**0-7**	**-**	**7**		reserved
c	**0-7**	**-**	**8**	UNDERVOLT	24V supply undervoltage
c	**0-7**	**-**	**9**	NOCOMM	no data received for too long a time
c	**0-7**	**0-7**	*****	LED-error; reset by switching ON and OFF Digit 3 = LED-channel: 0-7 = CW1,WW1,G1,R1,CW2,WW2,G2,R2 Digit 4 = error code, in case of multiple codes they are added (MADATAID_CANPAR_STATUS_LED_xxx)	
c	**0-7**	**0-7**	**1**	OFFCURR	current measured in driver OFF state
c	**0-7**	**0-7**	**2**	UNDERCURR	open circuit / cannot reach target current

c	**0-7**	**0-7**	**4**	OVERCURR	short circuit / measured current is too high
E	**0-9,A-F**	**0-9**	**0-9**	Control unit error in software-module 0-15	
F	**0-9,A-F**	**0-9**	**0-9**	Control unit error in software-module 16-31 Digit 2 = Module code modulo 16 (hex), see source code 'project.h', xxxx_MODULE_ID Digits 3+4 = decimal error code 00..99, see source code 'retval.h'	
E	**1**	*	*	MAIN_	
E	**2**	*	*	TIMER_	
E	**3**	*	*	WATCHDOG_	
E	**4**	*	*	CAN_	
E	**5**	*	*	CANCOM_	
E	**6**	*	*	EEDATA_	
E	**7**	*	*	FLASHCHK_	
E	**8**	*	*	CONTROL_	
E	**9**	*	*	CONTROL_REF_	
E	**A**	*	*	MOTOR_	
E	**b**	*	*	LEDCTRL_	
E	**C**	*	*	SWITCH_	
E	**d**	*	*	MMISLAVE_KEY_	
E	**E**	*	*	MMISLAVE_LED_	
E	**F**	*	*	LCD_	
F	**0**	*	*	USER_	
F	**1**	*	*	ADCINT_	
F	**2**	*	*	DIPSW_	
F	**3**	*	*	CRITVAR_	
*	*	**0**	**0**	OK	no error
*	*	**0**	**1**	ERR	general error
*	*	**0**	**2**	ERR_ILLEGAL_CASE	illegal case state in graph
*	*	**0**	**3**	ERR_ILLEGAL_ACT	illegal action state in graph
*	*	**0**	**4**	E_NULLPOINTER	a function has received a null pointer where not applicable
*	*	**0**	**5**	E_EXECFLAGNOTFALSE	execution flag was not false in graph
*	*	**0**	**6**	E_WDFAIL	watchdog test failed (watchdog did not reset the CPU correctly)
*	*	**0**	**7**	E_WDRESET	an unintended watchdog reset has occurred
*	*	**0**	**8**	E_FLASHCHK_FAIL	the FLASH CRC check failed
*	*	**1**	**0**	E_TICKOV	Ticker tasks overflow (tasks too slow)
*	*	**1**	**1**	E_SLOWTICKOV	Slow Ticker tasks overflow (tasks too slow)

8. Data

8.1. Technical data

Mach LED 2SC Hybrid	OT-Mode	Dental-Mode
Central light intensity	100.000 Lux (1 m distance)	30.000 Lux (0,7 m distance)
Colour rendering index R_a	95	95
Colour rendering index R_9	≥ 90	≥ 90
Focusable light field size	16-24 cm	9 x 5,5 cm (oval)
Electronic light intensity control	50 – 100 %	50 – 100 %
Colour temperature (Kelvin)	4300 K	4300 K
Temperature increase near head	0,5 °C	0,5 °C
Number of LED's	21	6
Working distance	70-140 cm	70-140 cm
Height adjustment	118 cm	118 cm

Remark:
The technical data are subject to fluctuations. Due to manufacturing reasons the real values can slightly differ from the data mentioned above.
The values for R_a and R_9 can differ with approx ± 5%.
The values for the colour temperature can differ with approx ± 200K.

8.2. Electrical data

Mach LED 2SC Hybrid	OT-Mode	Dental-Mod
Power consumption	30 W	10 W
Operating voltage	28 V DC	28 V DC
Current	1 A	0,4 A

8.3. Environmental conditions

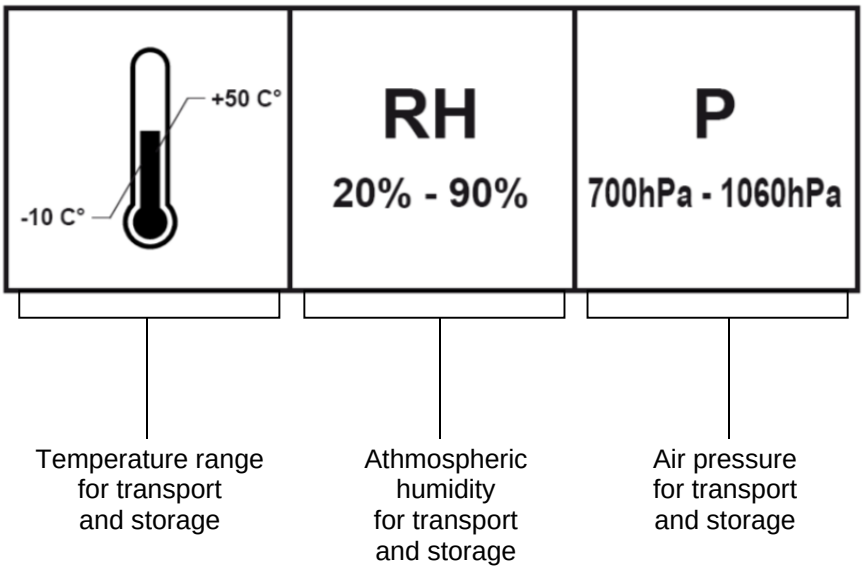
Operation

	Min.	Max.
Temperature	+10°C	+30°C
Relative atmospheric humidity	30 %	75 %
Air pressure	700 hPa	1060 hPa

Transport / storage

	Min.	Max.
Temperature	-10°C	+50°C
Relative atmospheric humidity	20 %	90 %
Air pressure	700 hPa	1060 hPa

References on the package



8.4. Important remarks

When using more than one OT-lamp at the same time (OT-lamp combinations), due to the light fields overlapping of different lights the maximum permissible values according to EN 60601-2-41 for UV-radiation (< 400 nm) of 10 W/m² can be exceeded.

Due to production-related reasons, some LED modules can show colour nuances during operation.
These colour nuances (greenish or reddish) are no fault of the light. The light quality and the function of the light are not affected.

When installing an OT-lamp, its fail-safety must be guaranteed according to DIN VDE 0100-710 (former DIN VDE 0107)

Attention!
The test certificate for the electrical safety test can be requested when needed. Please provide the serial number of the respective light.

The light must still be tested at commissioning.

Protective conductor

Alternating current

The polarity is very important for the installation of the light. In case the light does not function after installation, the polarity must be checked at the secondary side of the power supply.

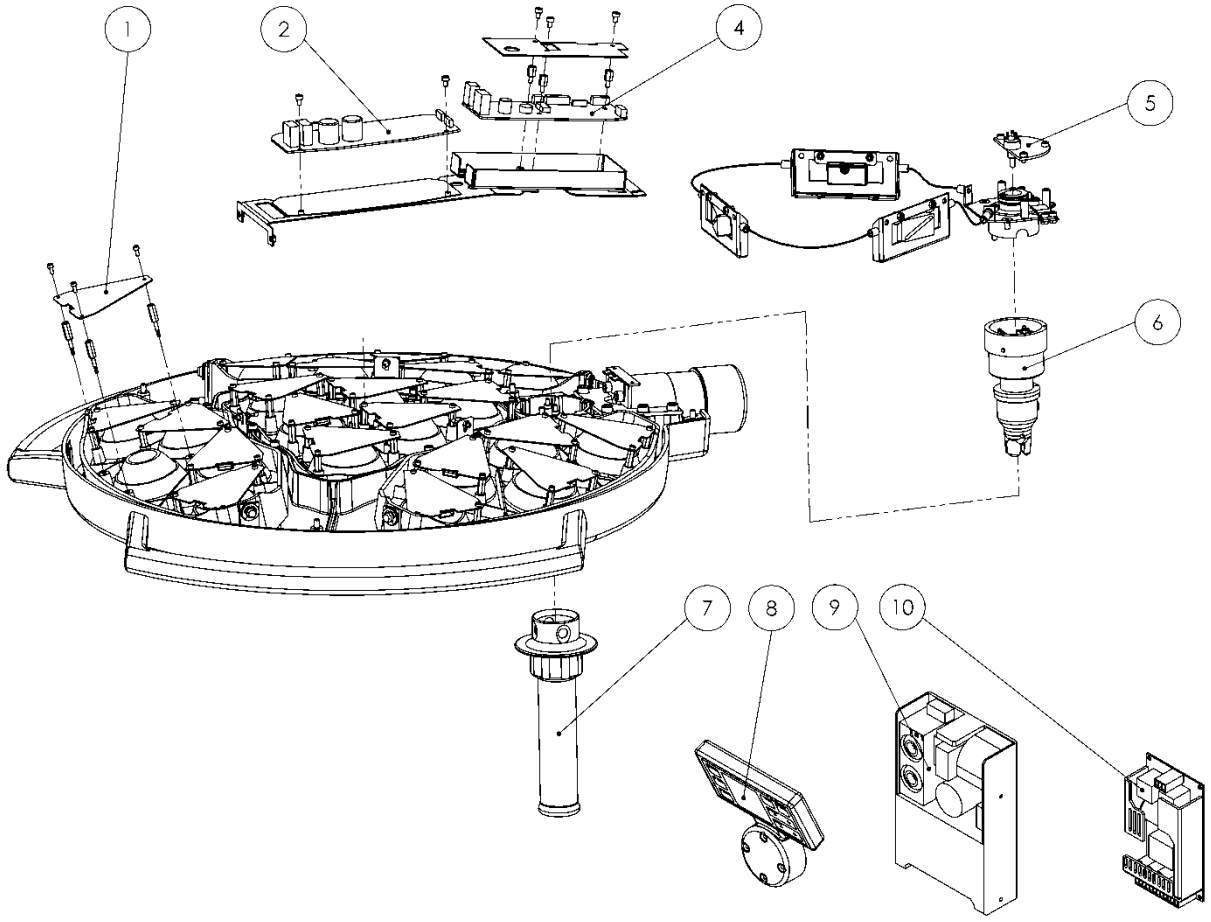
9. CE-mark

The products Mach LED 2SC Hybrid comply with the standards 93/42/EEC for medical products of the European Community's Council. Dr. Mach applies the standard EN 60601-2-41.
Dr. Mach GmbH is certified according to DIN EN ISO 13485:2003 + AC:2009.

10. Disposal

The OT-lamp doesn't contain any dangerous goods.
The components of the OT-lamp should be properly disposed at the end of its shelf-life.
Make sure, that the materials are carefully separated.
The electrical conducting boards should be submitted to an appropriate recycling proceeding.
The rest of the components should be disposed according to the contained materials.

11. Spare parts



Pos.	Spare part	Part No.
1	LED-module incl. cooling body for Mach LED 2SC Hybrid	67100607
2	Cluster board for Mach LED 2SC Hybrid	67150206
3		
4	Main electronic board for Mach LED 2SC Hybrid	67150207
5	Potentiometer with retaining plate	15086001
6	Handle adapter M for Mach LED 2SC Hybrid	18220001
7	Sterilisable handle sleeve	21150002
8	Keypad incl. holder for Mach LED 2SC Hybrid	16120001
9	Power supply 250W, incl. connecting cables	72000084
10	Power supply 100VA/230V for Mach LED 2SC Hybrid (wall model only)	67010406
	Set of cover caps for LED 2 housing	72000053

12. Electromagnetic compatibility

The Dr. Mach OT- and examination lights are subject to special preventive measures regarding the electromagnetic compatibility and must be installed according to the EMC-instructions mentioned in the accompanying documents.

The function of the OT- and examination lights can be affected by portable and mobile HF-communication devices.

Table 1 – Guidance and manufacturer´s declaration – electromagnetic emission – for all EQUIPMENT AND SYSTEMS (see 5.2.2.1 c)

1	**Guidance and manufacturer´s declaration – electromagnetic emission**		
2	The MACH LED 2SC Hybrid is intended for use in the electromagnetic environment specified below. The customer or the user of the MACH LED 2SC Hybrid should assure that it is used in such an environment.		
3	Emissions test	Compliance	Electromagnetic environment - guidance
7	Harmonic emissions IEC 61000-3-2	Class C	The MACH LED 2SC Hybrid is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
8	Voltage fluctuations / flicker emissions IEC 61000-3-3	Complies	
12	RF emissions CISPR 15	Complies	The MACH LED 2SC Hybrid is not suitable for interconnection with other equipment.

Table 2 – Guidance and manufacturer's declaration – electromagnetic immunity – for all EQUIPMENT and SYSTEMS (see 5.2.2.1 f)

Guidance and manufacturer´s declaration – electromagnetic immunity			
The MACH LED 2SC Hybrid is intended for use in the electromagnetic environment specified below. The customer or the user of the MACH LED 2SC Hybrid should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	± 6 kV contact ± 8 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30 %.
Electrical fast transient / burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines not applicable	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	< 5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (>95 % dip in U_T) for 5 sec	< 5 % U_T (>95 % dip in U_T) for 0,5 cycle 40 % U_T (60 % dip in U_T) for 5 cycles 70 % U_T (30 % dip in U_T) for 25 cycles < 5 % U_T (>95 % dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial or hospital environment. If the user of the MACH LED 2SC Hybrid requires continued operation during power mains interruptions, it is recommended that the MACH LED 2SC Hybrid be powered from an uninterruptible power supply or a battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	30 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
NOTE U_T is the a. c. mains voltage prior to application of the test level.			

Table 4 – Guidance and manufacturer´s declaration – electromagnetic immunity – for EQUIPMENT and SYSTEM that are not LIFE-SUPPORTING (see 5.2.2.2)

Guidance and manufacturer´s declaration – electromagnetic immunity			
The MACH LED 2SC Hybrid is intended for use in the electromagnetic environment specified below. The customer or the user of the MACH LED 2SC Hybrid should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Conducted RF IEC 61000-4-6	3 V 150 kHz to 80 MHz	3 V	Portable and mobile RF communications equipment should be used no closer to any part of the MACH LED 2SC Hybrid including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. **Recommended separation distance** $d = 1{,}17\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2,5 GHz	3 V/m	$d = 1{,}17\sqrt{P}$ 80 MHz to 800 MHz $d = 2{,}34\sqrt{P}$ 800 MHz to 2,5 GHz where *p* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in metres (m).[b] Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey,[a] should be less than the compliance level in each frequency range.[b] Interference may occur in the vicinity of equipment marked with the following symbol:

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.

NOTE 2 These guidelines may not apply in all situations. Electromagnetic is affected by absorption and reflection from structures, objects and people.

[a] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the MACH LED 2SC Hybrid is used exceeds the applicable RF compliance level above, the MACH LED 2SC Hybrid should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the MACH LED 2SC Hybrid.

[b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Table 6 – Recommended separation distances between portable and mobile RF communications equipment and the EQUIPMENT or SYSTEM - for EQUIPMENT and SYSTEMS that are not LIFE-SUPPORTING (see 5.2.2.2)

Recommended separation distances between portable and mobile RF communications equipment and the MACH LED 2SC Hybrid			
The MACH LED 2SC Hybrid is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the MACH LED 2SC Hybrid can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the MACH LED 2SC Hybrid as recommended below, according to the maximum output power of the communications equipment			
	Separation distance according to frequency of transmitter m		
Rated maximum output of transmitter W	150 kHz to 80 MHz $d = 1{,}17\sqrt{P}$	80 MHz to 800 MHz $d = 1{,}17\sqrt{P}$	800 MHz to 2,5 GHz $d = 2{,}34\sqrt{P}$
0,01	0,12	0,12	0,23
0,1	0,37	0,37	0,74
1	1,17	1,17	2,33
10	3,69	3,69	7,38
100	11,67	11,67	23,33
For transmitters rated at a maximum output power not listed above the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.			
NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.			
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			